A REVIEW OF RECURRING CONCUSSIONS AND ATHLETE’S RETURN TO PLAY

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INTRODUCTION

Concussions are prevalent among athletes of all ages that compete in contact sports. Concussions can be a dangerous injury because the brain is a sensitive organ that controls the entire body. In an effort to better understand concussions, we read a series of articles that conducted various experiments on mice and observational studies on athletes. The purpose of this abstract is to discuss these articles and summarize the findings. The abstract will consider: 1) the effect of rotational acceleration on the brain 2) vulnerability due to first concussion, 3) effects of multiple concussions compared to a singular concussion, 4) suggested return to play time-frames, and 5) possible research deficits and suggestions for future research.

ROTATIONAL ACCELERATION

Rowson et al. (2011) found mean rotational acceleration of the head above a certain threshold to be more likely to result in a concussion compared to below that threshold. The average sub-concussive rotational acceleration measured was 1230 ± 915 rad/s^2 while the average concussive rotational acceleration was 5022 ± 1791 rad/s^2. Rowson et al. (2011) also noted the importance of impulse. He concluded that the human head is able to better withstand greater magnitude accelerations over shorter periods of time. Once the duration increases, however the head is less tolerant. In the table below, Rowson et al. (2011) presents that both linear and rotational components of acceleration are related to concussion. Even though linear accelerations for each location are similar, the rotational acceleration and velocity vary significantly. This helps us to better understand that concussions occur not only due to the impact force and location, but also due to angular kinematics.

<table>
<thead>
<tr>
<th></th>
<th># of concussion</th>
<th>Linear Acc. (g)</th>
<th>Rot. Acc. (rad/s/s)</th>
<th>Rot. Vel. (rad/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sag. Plan Rotation</td>
<td>33</td>
<td>102.7±33.6</td>
<td>4986±1909</td>
<td>22.1±8.5</td>
</tr>
<tr>
<td>Cor. Plane Rotation</td>
<td>7</td>
<td>105.8±16.6</td>
<td>5192±1166</td>
<td>23.0±5.2</td>
</tr>
<tr>
<td>Impacts to top</td>
<td>17</td>
<td>100.6±37.1</td>
<td>2192±1790</td>
<td>9.7±7.9</td>
</tr>
</tbody>
</table>

VULNERABILITY

It was proposed that after one concussion, the brain becomes more vulnerable and more likely to suffer from another concussion. Research disagrees on the duration of the time period of vulnerability. Helmut et al (2001) concludes that the brain has an increased vulnerability to a second injury within the subsequent 24 hours after the initial impact. In contrast, TheRiault et al. (2009) suggested that time frame is up to 22 months after the initial injury. This window is due to a delayed reaction time which makes it harder for the athlete to react to avoid injury. Longhi et al. (2005) concluded that injury is more severe after a second concussion within three to five days, but after seven days there was little difference. This paper showed that the brain may not necessarily be more likely to receive a second injury, but it is more vulnerable (damageable) because the effects become more severe after a second injury.
MULTIPLE CONCUSSIONS

Helmut et al. (2001) showed that after a single injury, neurological motor function revealed minimal impairment, but after multiple injuries, there was significant impairment. Also interesting is that Macciocchi et al. (2001) reported that football players that sustained more head injuries reported more symptoms, compared to those that had only one injury. This suggests that multiple concussions either magnify the symptoms of the original concussion, or cause a different type of damage, thus causing new symptoms.

RETURN TO PLAY

Among the various articles that studied athletic teams, it was mentioned that the players knew it was best to wait after a concussion before returning to play, but Guskiewicz et al. (2000) made it clear that the majority of athletes ignored the suggestion, often going back into the game on the same day. Guskiewicz et al. (2000) also stated that the general rule for return to play is that the athlete should be symptom-free for at least twenty minutes. The findings of the other, experiment-based articles make it seem as though the guideline of twenty minutes should be extended to multiple hours, if not days, due to the increased vulnerability. Longhi et al. (2005) found that the vulnerability can last for up to three days; Helmut (2001) found that window to be about twenty-four hours. Both of these extend beyond the twenty minute guideline found in Guskiewicz et al. (2000).

LIMITATIONS/FUTURE RESEARCH

The research articles that one can encounter are limited in scope. The experiments on mice and rats make it hard to extrapolate to the human population because of physiological and anatomical differences. A limitation of the studies done on humans is that once the person is injured, scientists cannot ethically take coronal cuts of the person’s brain to see the actual neuronal effects. Researchers can simply perform evaluative exams, which may or may not get at the actual physiological issue.

SUMMARY

The issue of concussions in athletics has gotten a lot of attention lately, and rightly so. There do seem to be differences in the effects of a singular concussion compared to the effects of multiple concussions. The consensus appears to be that a first concussion predisposes an athlete to a second concussion, but the time frame of that increased risk is debated. There also seems to be direct correlation between concussions and rotational acceleration of the head upon impact. This helps us to better understand the cause of concussion and what we might do in order to help athletes reduce that acceleration. There also seems to be total agreement that a second concussion leads to more numerous and serious effects than a single concussion. However, the correlation between animal studies and human experience is still in question.

REFERENCES


